# Hydrogeologic Susceptibility and Vulnerability Assessment for National Outdoor Leadership School Drinking Water Well, Sutton, Alaska

DRINKING WATER PROTECTION PROGRAM REPORT 115

September 2001

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By Catherine Baxter, B.E.S.T. Resource

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ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION: 2001

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By Catherine Baxter, B.E.S.T. Resource

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**Drinking Water Protection Program**
**Alaska Department of Environmental Conservation**

## EXECUTIVE SUMMARY

The National Outdoor Leadership School is a Class B (transient/noncommunity) drinking water source consisting of one well. Identified potential and current sources of contaminants for National Outdoor Leadership School include: roads, septic systems and residential acreage. This existing and potential source of contamination is considered a source of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, National Outdoor Leadership School public water source received a vulnerability rating of **Low** for bacteria and viruses, nitrates and/or nitrites, and for volatile organic chemicals.

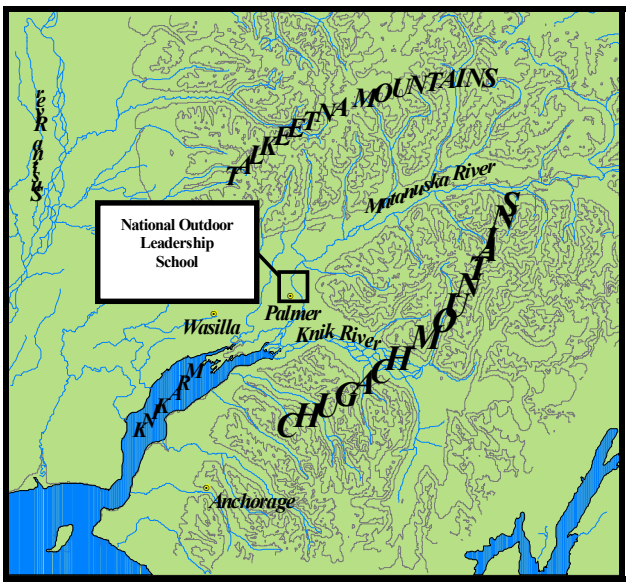


**Figure 1. Index map showing the location of well assessment**

## INTRODUCTION

The purpose of this environmental assessment is to provide public water system owners/operators, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. This assessment was completed for the National Outdoor Leadership School source of public drinking water. This source consists of one well in the Sutton area (Figure 1). This assessment, known under the Alaska Drinking Water Protection Program as the *Source Water Assessment*, has combined a review of the natural hydrogeologic sensitivity with potential and existing contaminant risks to arrive at an overall vulnerability of the drinking water source to contamination. This assessment has been completed as a basis for local voluntary protection efforts and to assist agencies in their efforts to reduce risk to this public drinking water supply.

## DESCRIPTION OF THE MATANUSKA-SUSITNA VALLEY-AREA, ALASKA

### Location

The Matanuska-Susitna Valley is part of the lowland lying about 50 miles north of Anchorage in south-central Alaska. The well described in this report is part of the Matanuska River Watershed. This study area is roughly bounded on the north by the Talkeetna Mountains; on the west by Wasilla Creek; on the south by the Knik River; and on the east by the Chugach Mountains. The area covers approximately 150 square miles.

### Climate

The climate of the Matanuska-Susitna Valley is the result of a combination of marine and continental influences. The climate is somewhat transitional in that it does not experience large daily and annual temperature fluctuations like those experienced in the interior of Alaska nor does it experience high amounts of precipitation typified by gulf coast regions. Mean annual precipitation is approximately 15 inches per year. On the average, the Valley receives a total snow accumulation of 58 inches per year. Precipitation generally increased inland toward the Talkeetna Mountains where annual precipitation may exceed 60 inches. Mean daily temperature ranges from 67$^{o}$ F during July to 5$^{o}$ F in January [*Western Regional Climate Center*, 2000].

**Physiography and Groundwater Conditions**

The Matanuska-Susitna Valley is surrounded by rugged mountains that rise abruptly from the valley floor. The Chugach Mountains at the southern edge of the valley reach altitudes greater than 6300 feet. These mountains are composed primarily of metamorphosed sedimentary marine and volcanic rocks, and greenstone of Mesozoic age. Along the northern edge of the valley, peaks in the Talkeetna Mountains reach altitudes of 3000 to 5000 feet. The Talkeenta Mountains are composed mainly of igneous rocks, chiefly granitic intrusives (Mesozoic?) and subordinate lavas and tuffs; Cretaceous and Tertiary sedimentary rocks form the south flank of the mountains. Although the altitude of the valley floor ranges from sea level at Knik Arm to 1000 feet at the base of Wishbone Hill, the local relief is commonly not more than 100 to 200 feet.

The Matanuska and Knik River's drain the area. These rivers are braided glacial outwash streams having wide floodplains. Drainage is poor in many interstream tracts resulting in large areas of swampy ground with shallow lakes occupying depressions.

The Matanuska-Susitna Valley is floored with unconsolidated deposits, chiefly glacial drift, that represents several episodes of glacial advances and retreats. The drift includes till, outwash stream deposits, and estuarine and lake deposits. Physiographic features formed by these deposits in or adjacent to the study area include end moraine, lateral moraines, eskers, crevasse fillings, and other pitted features, river terraces, outwash floodplains and an extensive estuarine flat (Trainer, 1960).

The glacial till and bedrock form aquifers of minor importance. The chief hydrologic significance of the till is in confining the artesian aquifer. Generally, the till is poorly permeable, although locally thin layers of sand may yield small quantities of water. Till that is present at or near the land surface in much of the area makes the acquisition of shallow groundwater difficult. The bedrock is poorly permeable. It yields water only from fractures, whose location and frequency cannot be easily predicted.

The chief aquifers are composed of outwash sand and gravel laid down by melt-water streams or in lakes. The outwash deposits are of two chief forms. The first consists of sheet-like deposits that lie just beneath the ground surface. These deposits range in thickness from a few feet to more than 100 feet. They typically rest on till or bedrock. The water in these deposits is unconfined. The other outwash deposits are buried beneath till. They are known to be as much as 50 to 60 feet thick, and probably are considerably thicker in some places. They commonly contain confined, or artesian, groundwater. Well logs and data from pumping tests suggest that outwash sand and gravel form a continuous or nearly continuous sheet in an area of more than 10 square miles north and west of Palmer (Jakola et al, 1991).

Recharge of the groundwater is chiefly from precipitation but it is likely that only a small proportion of the annual precipitation reaches the water body. During very dry seasons conspicuous declines in of water levels occur in many wells. Along the mountain fronts, groundwater seeps from fractures in bedrock into the sediments. At these higher elevations, rain and snowmelt also enter the sediments. Lastly, aquifers may be recharged by streams where surface water percolates into surrounding permeable sediments (losing reaches of streams). This is the case for the water-table aquifers in the terrace south of Palmer and in the Bodenburg Butte area, which receive underground flow from the Matanuska River. Groundwater flow in the confined aquifers is generally from the north and north-northwest. The direction of groundwater flow in the upper unconfined aquifer is more variable due to the influence from surficial topography as well as its close connection with surface water bodies (Trainer,1960).

**NATIONAL OUTDOOR LEADERSHIP SCHOOL PUBLIC WATER SOURCE**

National Outdoor Leadership School public water source is a Class B (transient/noncommunity) water source, which is privately owned and operated. The source consists of one well near the base of the Talkeetna Mountains at an elevation of 550 feet above sea level. The well is located on Farm Loop Road West of the Glennallen Highway approximately 3 miles northwest of Palmer. According to the well log, National Outdoor Leadership School does appears to be grouted, and functioning properly. The well penetrates gravel and silty sand to 90 feet below land surface. The well does not appear to be screened. The well static water level was not reported.

The water system at National Outdoor Leadership School consists of a hydropneumatic pressure tank, and jet pump. This water source operates year round. The National Outdoor Leadership School drinking water source collectively serves approximately 30 residents and non-residents through four service connections.

## ASSESSMENT AND PROTECTION AREA FOR NATIONAL OUTDOOR LEADERSHIP SCHOOL DRINKING WATER SOURCE

The Drinking Water Protection and Assessment Area that has been established for National Outdoor Leadership School is the area that is most sensitive to contamination. This area has served as a basis for assessing the risk of the drinking water source to contamination. This zone around the drinking water source is the most critical area for the preservation of the quality of the drinking water for this source. For simplicity, this area will be known as your Drinking Water Protection Area and will serve as the area of focus for voluntary protection efforts.

Conceptually, groundwater enters the aquifer systems along the front range of the Talkeetna Mountains and flows toward Cook Inlet. An analytical calculation was used to calculate the size and shape of the area that contributes water to the well. The input parameters describing the attributes of the aquifer in this calculation were adopted from the well log and the recent Sanitary Survey. This analytical calculation was used as a guide in establishing the protection area for National Outdoor Leadership School. Additional methods were further employed to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful and conservative protection area with respect to public health (Please refer to the Guidance Manual for Class B Public Water Systems for additional information).

The Drinking Water Protection Areas established for wells by the Alaska Department of Environmental Conservation (ADEC) are separated into zones. These zones correspond to a time-of-travel. Time-of-travel is the time required for water to move in the saturated zone of the ground from a specific point to the well. The Drinking Water Protection Areas for National Outdoor Leadership School contains four zones, Zone A, Zone B, Zone C and Zone D (Map 1, Appendix A). Zone A corresponds to the area between the well and the distance equal to ¼ of the distance of the 2-year time-of-travel. Depending on where a contaminant source is located within Zone A, travel time for a contaminant to reach the well may be on the order of several days to several hours. Zone A also extends down gradient from the well to take into account the area of the aquifer that is influenced by pumping of the well.

The Zone B protection area for National Outdoor Leadership School corresponds to a time-of-travel of less than two years and extends toward base of the Talkeetna Mountains. Zone C protection area corresponds to a time-of-travel of greater than 2 years and less than 5 years. Zone D corresponds to a time-of-travel of greater than 5 years and less than 10 years.

## INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within National Outdoor Leadership School Drinking Water Protection Area. This survey was completed through a search of agency records and other publicly available information.

Potential sources of contamination to drinking water supplies cover a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For the basis of this assessment and all Class B public water system assessments, three categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses
- Nitrates and/or nitrites
- Volatile organic chemicals.

Table 1 in Appendix C lists the Contaminant Source Inventory for National Outdoor Leadership School. Inventoried potential sources of contamination within Zone A were attributed to roads. Inventoried potential sources of contamination within Zones B & C were roads, residential septic systems and lawns and gardens. Zone D contained only natural wilderness and was not considered in determining the vulnerability of this drinking water source to contamination. Below is a summary of the contaminant sources inventoried within the National Outdoor Leadership School protection area:

- Roads
- Residential Septic Systems
- Lawns and Gardens.

This potential contaminant source presents risks for all three categories of drinking water contaminants for National Outdoor Leadership School drinking water source.

## RANKING OF CONTAMINANT RISKS

Potential and existing sources of contamination have been identified, sorted, and ranked according to what type and level of risk they represent. Ranking of contaminant risks for a "potential" or "existing" source of contamination is a function of toxicity and volumes of specific contaminants associated with that source. Contaminant risks are further a function of the number and density of those types of contaminant sources as well as the proximity of those sources to the well (Appendices B & C).

## VULNERABILITY OF NATIONAL OUTDOOR LEADERSHIP SCHOOL DRINKING WATER SOURCES

Vulnerability of a drinking water source to contamination is a combination of two factors:

- Natural susceptibility; and
- Contaminant risks.

Each of the three categories of drinking water contaminants has been analyzed and an overall vulnerability score of 0 to 100 is ultimately assigned:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

Vulnerability of the
Drinking Water Source to Contamination (0 – 100).

A score for the Natural Susceptibility is achieved by analyzing the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)
+
Susceptibility of the Aquifer (0 – 25 Points)

= Natural Susceptibility (Susceptibility of the Well)
(0 – 50 Points)

National Outdoor Leadership School is completed in an unconfined aquifer setting. The well penetrates 90 feet of sandy and silty gravel. This volume of material, may provide a protective barrier for the movement of contaminants in the subsurface. However, near the base of the Talkeetna Mountains, the till layers tend to be discontinuous and thin toward the mountains. Therefore, contaminants that enter the subsurface near the base of the mountains may enter the confined aquifer uninhibited by any protective layer. This well appears to be properly grouted as indicated from information obtained from ADEC records. Combining the susceptibilities of the wellhead and the aquifer to contamination leads to a score (0 – 50 points) and rating of overall Susceptibility (Appendix D). Table 1 shows the overall Susceptibility score and rating for National Outdoor Leadership School.

**Table 1. Natural Susceptibility - Susceptibility of the Wellhead and Aquifer to Contamination**

| | Score | Rating |
|---|---|---|
| Susceptibility of the Wellhead | 0 | Low |
| Susceptibility of the Aquifer | 19 | High |
| Natural Susceptibility | 19 | Low |

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. Fourteen roads, 56 residential septic systems and approximately 232 residential acres contribute to the potential contamination to the National Outdoor Leadership School source of public drinking water.

A score (0 – 50 points) and rating of Contaminant Risks (Appendix D) is assigned based on the findings of the Contaminant Source Inventory (Appendix B - Table 1 – Table 7). This portion of the analysis examines any existing or historical contamination that has been detected at the drinking water source through routine sampling. It also reviews contamination that has or may have occurred but has not arrived or been detected at the well. Table 2 summarizes the Contaminant Risks for each category of drinking water contaminants.

**Table 2. Contaminant Risks**

| Contaminant Risks | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 10 | Low |
| Nitrates and/or Nitrites | 13 | Low |
| Volatile Organic Chemicals | 10 | Low |

Appendix D contains eight charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well

and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred but has not arrived or been detected at the well. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 8 contain the Contaminant Risks and Vulnerability Analysis for nitrates and nitrites and volatile organic chemicals, respectively.

Vulnerability of the drinking water source to contamination is the combination of susceptibility of the aquifer and the well with contaminant risks. Table 3 contains the overall vulnerability scores (0 – 100) and ratings for each of the three categories of drinking water contaminants (Appendix D). Note: scores are rounded off to the nearest five.

**Table 3. Overall Vulnerability of National Outdoor Leadership School Public Drinking Water Source to Contamination by Category**

| Category | Score | Rating |
|---|---|---|
| Bacteria and Viruses | 30 | Low |
| Nitrates and Nitrites | 30 | Low |
| Volatile Organic Chemicals | 30 | Low |

Tables 2 through 4 in Appendix B contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

The roads, residential septic systems and lawns and gardens in Zone A, B and C are the driving factors in determining contaminant risks for all categories of contaminants (See "Overall Rank after Analysis" in Table 2 – 4 of Appendix B).

Bacteria and Viruses were not detected in the source waters of National Outdoor Leadership School. Combining the sampling history with the susceptibility of the well then yields an overall low vulnerability to contamination in this category.

Sampling history of National Outdoor Leadership School source waters indicate low concentrations of nitrate (See Chart 6 – Contaminant Risks for Nitrates/Nitrites in Appendix D). Existing nitrate contamination is approximately 3% of the allowable limit (MCL) for this contaminant. Due to the high solubility and weak retention by soil, nitrates are very mobile in soil, moving at approximately the same rate as water. The current nitrate concentration in National Outdoor Leadership School remains at safe levels with respect to human health.

Overall, contaminant risks for the nitrate/nitrite category are medium due to the roads, septic systems and residential acreage present up gradient from the well. Combining potential nitrate and/or nitrite contamination risk with the susceptibility of the well yields an overall medium vulnerability to contamination in this category.

Volatile Organic Chemicals were not detected in the source waters of National Outdoor Leadership School. Combining the sampling history with the susceptibility of the well then yields an overall low vulnerability to contamination in this category.

**SUMMARY**

A *Source Water Assessment* has been completed for the National Outdoor Leadership School source of public drinking water. The overall vulnerability of this source to contamination is medium for bacteria and viruses, high for nitrates and/or nitrites, and medium for volatile organic chemicals. This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of the National Outdoor Leadership School to protect public health. It is anticipated that *Source Water Assessments* will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the public drinking water source.

# REFERENCES CITED

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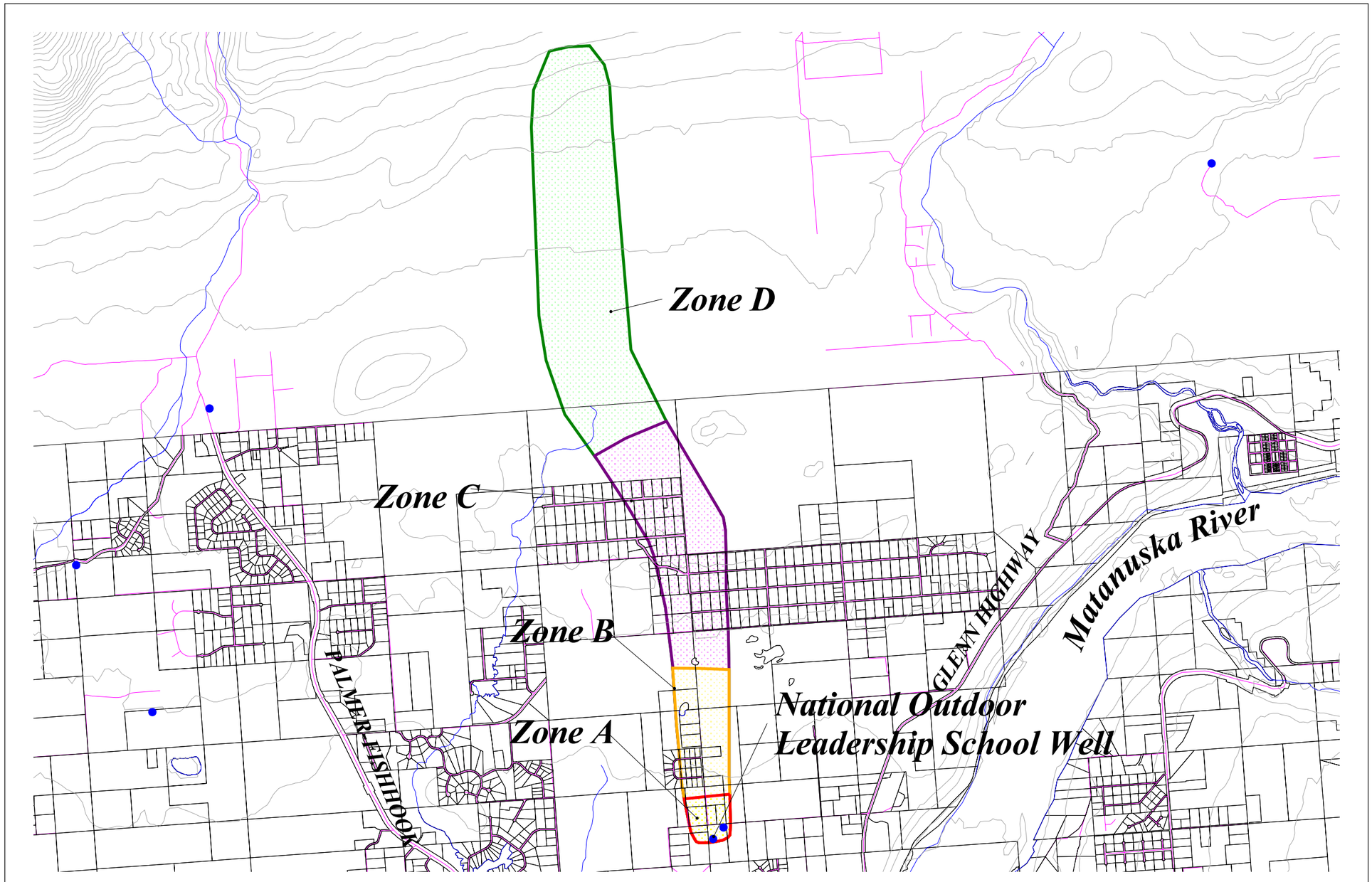
# APPENDIX A

# National Outdoor Leadership School
# Drinking Water Protection Area

# National Outdoor Leadership School (PWSID 227615)
# Drinking Water Protection Areas




10000 0 10000 20000 Feet

N

- Public Water System Wells
- Lakes and Rivers
- Zone A Protection Area
  Several Months to 2 Years
  Travel Time
- Zone B Protection Area
  Less Than 2 Years
  Travel Time
- Zone C Protection Area
  2 to 5 Years Travel Time
- Zone D Protection Area
  5 to 10 Years Travel Time
- Roads
- Mat-Su Borough Parcel
  Boundaries
- Elevation Contours

## Map 1

Prepared by: B.E.S.T. Resource

# APPENDIX B

## Contaminant Source Inventory and Risk Ranking for National Outdoor Leadership School

**Table 1**

# Contaminant Source Inventory for National Outdoor Leadership School

**PWSID 227615.001**

| Contaminate Source Category | Contaminant Source ID | CS ID Tag | Zone | Location | Map | Comments |
|---|---|---|---|---|---|---|
| Lawns and gardens | R1 | R1-1 | C | Located north of the well | 2 | |
| Lawns and gardens | R1 | R1-2 | B | Located north of the well | 2 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-1 | C | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-2 | C | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-3 | C | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-4 | C | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-5 | C | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-6 | C | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-7 | C | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-8 | C | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-9 | C | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-10 | C | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-11 | C | Yarrow St. | 3 | |

# Contaminant Source Inventory for National Outdoor Leadership School



| Contaminate Source Category | Contaminant Source ID | CS ID Tag | Zone | Location | Map | Comments |
|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-12 | C | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-13 | C | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-14 | C | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-15 | C | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-16 | C | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-17 | C | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-18 | C | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-19 | C | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-20 | C | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-21 | C | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-22 | C | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-23 | C | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-24 | C | Norman | 3 | |

# Contaminant Source Inventory for National Outdoor Leadership School



| Contaminate Source Category | Contaminant Source ID | CS ID Tag | Zone | Location | Map | Comments |
|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-25 | C | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-26 | C | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-27 | C | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-28 | C | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-29 | C | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-30 | C | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-31 | C | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-32 | C | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-33 | C | Soapstone | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-34 | C | Soapstone | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-35 | C | Soapstone | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-36 | C | Soapstone | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-37 | C | Jensen | 3 | |

# Contaminant Source Inventory for National Outdoor Leadership School

| Contaminate Source Category | Contaminant Source ID | CS ID Tag | Zone | Location | Map | Comments |
|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-38 | C | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-39 | C | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-40 | C | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-41 | B | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-42 | B | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-43 | B | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-44 | B | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-45 | B | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-46 | B | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-47 | B | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-48 | B | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-49 | B | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-50 | B | Weathervane | 4 | |

# Contaminant Source Inventory for National Outdoor Leadership School



| Contaminate Source Category | Contaminant Source ID | CS ID Tag | Zone | Location | Map | Comments |
|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-51 | B | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-52 | B | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-53 | B | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-54 | B | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-55 | B | Weathervane | 4 | |
| Highways and roads, dirt/gravel | X24 | X24-1 | C | Yarrow St. | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-2 | C | Evergreen | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-3 | C | Lupine | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-4 | C | Hermann | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-5 | C | Norman Dr | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-6 | C | Norman St | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-7 | C | Evergreen | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-8 | C | Hermann | 3 | |

# Contaminant Source Inventory for National Outdoor Leadership School



| Contaminate Source Category | Contaminant Source ID | CS ID Tag | Zone | Location | Map | Comments |
|---|---|---|---|---|---|---|
| Highways and roads, dirt/gravel | X24 | X24-9 | C | Norman Cr | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-10 | C | Williams | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-11 | C | Soapstone | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-12 | C | Jensen | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-13 | B | Britchenstrap | 4 | |
| Highways and roads, dirt/gravel | X24 | X24-14 | B | Weathervane | 4 | |

Table 2

# Potential and Existing Sources of Contamination for National Outdoors Leadership School Bacterias and Viruses

PWSID 227615.001

| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Lawns and gardens | R1 | R1-1 | C | Low | 1 | Located north of the well | 2 | Acreage exceeding 275 |
| Lawns and gardens | R1 | R1-2 | B | Low | 2 | Located north of the well | 2 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-1 | C | Very Low | 3 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-2 | C | Very Low | 4 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-3 | C | Very Low | 5 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-4 | C | Very Low | 6 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-5 | C | Very Low | 7 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-6 | C | Very Low | 8 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-7 | C | Very Low | 9 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-8 | C | Very Low | 10 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-9 | C | Very Low | 11 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-10 | C | Very Low | 12 | Yarrow St. | 3 | |

# Potential and Existing Sources of Contamination for National Outdoors Leadership School Bacterias and Viruses



| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-11 | C | Very Low | 13 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-12 | C | Very Low | 14 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-13 | C | Very Low | 15 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-14 | C | Very Low | 16 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-15 | C | Very Low | 17 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-16 | C | Very Low | 18 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-17 | C | Very Low | 19 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-18 | C | Very Low | 20 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-19 | C | Very Low | 21 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-20 | C | Very Low | 22 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-21 | C | Very Low | 23 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-22 | C | Very Low | 24 | Norman | 3 | |

# Potential and Existing Sources of Contamination for National Outdoors Leadership School Bacterias and Viruses



| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-23 | C | Very Low | 25 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-24 | C | Very Low | 26 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-25 | C | Very Low | 27 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-26 | C | Very Low | 28 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-27 | C | Very Low | 29 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-28 | C | Very Low | 30 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-29 | C | Very Low | 31 | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-30 | C | Very Low | 32 | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-31 | C | Very Low | 33 | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-32 | C | Very Low | 34 | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-33 | C | Very Low | 35 | Soapstone | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-34 | C | Very Low | 36 | Soapstone | 3 | |

# Potential and Existing Sources of Contamination for National Outdoors Leadership School Bacterias and Viruses

| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-35 | C | Very Low | 37 | Soapstone | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-36 | C | Very Low | 38 | Soapstone | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-37 | C | Very Low | 39 | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-38 | C | Very Low | 40 | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-39 | C | Very Low | 41 | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-40 | C | Very Low | 42 | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-41 | B | Very Low | 43 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-42 | B | Very Low | 44 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-43 | B | Very Low | 45 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-44 | B | Very Low | 46 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-45 | B | Very Low | 47 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-46 | B | Very Low | 48 | Weathervane | 4 | |

# Potential and Existing Sources of Contamination for National Outdoors Leadership School Bacterias and Viruses



| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-47 | B | Very Low | 49 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-48 | B | Very Low | 50 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-49 | B | Very Low | 51 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-50 | B | Very Low | 52 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-51 | B | Very Low | 53 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-52 | B | Very Low | 54 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-53 | B | Very Low | 55 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-54 | B | Very Low | 56 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-55 | B | Very Low | 57 | Weathervane | 4 | |
| Highways and roads, dirt/gravel | X24 | X24-1 | C | Very Low | 58 | Yarrow St. | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-2 | C | Very Low | 59 | Evergreen | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-3 | C | Very Low | 60 | Lupine | 3 | |

# Potential and Existing Sources of Contamination for National Outdoors Leadership School Bacterias and Viruses



| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Highways and roads, dirt/gravel | X24 | X24-4 | C | Very Low | 61 | Hermann | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-5 | C | Very Low | 62 | Norman Dr | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-6 | C | Very Low | 63 | Norman St | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-7 | C | Very Low | 64 | Evergreen | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-8 | C | Very Low | 65 | Hermann | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-9 | C | Very Low | 66 | Norman Cr | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-10 | C | Very Low | 67 | Williams | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-11 | C | Very Low | 68 | Soapstone | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-12 | C | Very Low | 69 | Jensen | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-13 | B | Very Low | 70 | Britchenstrap | 4 | |
| Highways and roads, dirt/gravel | X24 | X24-14 | B | Very Low | 71 | Weathervane | 4 | |

**Table 3**

# Potential and Existing Sources of Contamination for National Outdoor Leadership School Nitrates and Nitrites

**PWSID 227615.001**

| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Lawns and gardens | R1 | R1-1 | C | Low | 1 | Located north of the well | 2 | Acreage exceeding 275 |
| Lawns and gardens | R1 | R1-2 | B | Low | 2 | Located north of the well | 2 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-1 | C | Very Low | 3 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-2 | C | Very Low | 4 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-3 | C | Very Low | 5 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-4 | C | Very Low | 6 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-5 | C | Very Low | 7 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-6 | C | Very Low | 8 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-7 | C | Very Low | 9 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-8 | C | Very Low | 10 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-9 | C | Very Low | 11 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-10 | C | Very Low | 12 | Yarrow St. | 3 | |

# Potential and Existing Sources of Contamination for National Outdoor Leadership School Nitrates and Nitrites

| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-11 | C | Very Low | 13 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-12 | C | Very Low | 14 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-13 | C | Very Low | 15 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-14 | C | Very Low | 16 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-15 | C | Very Low | 17 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-16 | C | Very Low | 18 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-17 | C | Very Low | 19 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-18 | C | Very Low | 20 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-19 | C | Very Low | 21 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-20 | C | Very Low | 22 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-21 | C | Very Low | 23 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-22 | C | Very Low | 24 | Norman | 3 | |

# Potential and Existing Sources of Contamination for National Outdoor Leadership School Nitrates and Nitrites



| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-23 | C | Very Low | 25 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-24 | C | Very Low | 26 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-25 | C | Very Low | 27 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-26 | C | Very Low | 28 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-27 | C | Very Low | 29 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-28 | C | Very Low | 30 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-29 | C | Very Low | 31 | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-30 | C | Very Low | 32 | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-31 | C | Very Low | 33 | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-32 | C | Very Low | 34 | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-33 | C | Very Low | 35 | Soapstone | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-34 | C | Very Low | 36 | Soapstone | 3 | |

# Potential and Existing Sources of Contamination for National Outdoor Leadership School Nitrates and Nitrites

| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-35 | C | Very Low | 37 | Soapstone | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-36 | C | Very Low | 38 | Soapstone | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-37 | C | Very Low | 39 | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-38 | C | Very Low | 40 | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-39 | C | Very Low | 41 | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-40 | C | Very Low | 42 | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-41 | B | Very Low | 43 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-42 | B | Very Low | 44 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-43 | B | Very Low | 45 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-44 | B | Very Low | 46 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-45 | B | Very Low | 47 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-46 | B | Very Low | 48 | Weathervane | 4 | |

# Potential and Existing Sources of Contamination for National Outdoor Leadership School Nitrates and Nitrites



| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-47 | B | Very Low | 49 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-48 | B | Very Low | 50 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-49 | B | Very Low | 51 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-50 | B | Very Low | 52 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-51 | B | Very Low | 53 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-52 | B | Very Low | 54 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-53 | B | Very Low | 55 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-54 | B | Very Low | 56 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-55 | B | Very Low | 57 | Weathervane | 4 | |
| Highways and roads, dirt/gravel | X24 | X24-1 | C | Very Low | 58 | Yarrow St. | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-2 | C | Very Low | 59 | Evergreen | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-3 | C | Very Low | 60 | Lupine | 3 | |

# Potential and Existing Sources of Contamination for National Outdoor Leadership School Nitrates and Nitrites



| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Highways and roads, dirt/gravel | X24 | X24-4 | C | Very Low | 61 | Hermann | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-5 | C | Very Low | 62 | Norman Dr | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-6 | C | Very Low | 63 | Norman St | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-7 | C | Very Low | 64 | Evergreen | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-8 | C | Very Low | 65 | Hermann | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-9 | C | Very Low | 66 | Norman Cr | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-10 | C | Very Low | 67 | Williams | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-11 | C | Very Low | 68 | Soapstone | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-12 | C | Very Low | 69 | Jensen | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-13 | B | Very Low | 70 | Britchenstrap | 4 | |
| Highways and roads, dirt/gravel | X24 | X24-14 | B | Very Low | 71 | Weathervane | 4 | |

# Potential and Existing Sources of Contamination for National Outdoor Leadership School Volatile Organic Chemicals (VOCs)



| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Lawns and gardens | R1 | R1-1 | C | Low | 1 | Located north of the well | 2 | Acreage exceeding 275 |
| Lawns and gardens | R1 | R1-2 | B | Low | 2 | Located north of the well | 2 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-1 | C | Very Low | 3 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-2 | C | Very Low | 4 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-3 | C | Very Low | 5 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-4 | C | Very Low | 6 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-5 | C | Very Low | 7 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-6 | C | Very Low | 8 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-7 | C | Very Low | 9 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-8 | C | Very Low | 10 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-9 | C | Very Low | 11 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-10 | C | Very Low | 12 | Yarrow St. | 3 | |

# Potential and Existing Sources of Contamination for National Outdoor Leadership School Volatile Organic Chemicals (VOCs)

| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-11 | C | Very Low | 13 | Yarrow St. | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-12 | C | Very Low | 14 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-13 | C | Very Low | 15 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-14 | C | Very Low | 16 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-15 | C | Very Low | 17 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-16 | C | Very Low | 18 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-17 | C | Very Low | 19 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-18 | C | Very Low | 20 | Lupine | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-19 | C | Very Low | 21 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-20 | C | Very Low | 22 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-21 | C | Very Low | 23 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-22 | C | Very Low | 24 | Norman | 3 | |

# Potential and Existing Sources of Contamination for National Outdoor Leadership School Volatile Organic Chemicals (VOCs)

| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-23 | C | Very Low | 25 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-24 | C | Very Low | 26 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-25 | C | Very Low | 27 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-26 | C | Very Low | 28 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-27 | C | Very Low | 29 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-28 | C | Very Low | 30 | Norman | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-29 | C | Very Low | 31 | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-30 | C | Very Low | 32 | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-31 | C | Very Low | 33 | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-32 | C | Very Low | 34 | Williams | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-33 | C | Very Low | 35 | Soapstone | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-34 | C | Very Low | 36 | Soapstone | 3 | |

# Potential and Existing Sources of Contamination for National Outdoor Leadership School Volatile Organic Chemicals (VOCs)



| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-35 | C | Very Low | 37 | Soapstone | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-36 | C | Very Low | 38 | Soapstone | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-37 | C | Very Low | 39 | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-38 | C | Very Low | 40 | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-39 | C | Very Low | 41 | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-40 | C | Very Low | 42 | Jensen | 3 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-41 | B | Very Low | 43 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-42 | B | Very Low | 44 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-43 | B | Very Low | 45 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-44 | B | Very Low | 46 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-45 | B | Very Low | 47 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-46 | B | Very Low | 48 | Weathervane | 4 | |

# Potential and Existing Sources of Contamination for National Outdoor Leadership School Volatile Organic Chemicals (VOCs)



| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Septic systems (serves one or more single-family homes) | R2 | R2-47 | B | Very Low | 49 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-48 | B | Very Low | 50 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-49 | B | Very Low | 51 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-50 | B | Very Low | 52 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-51 | B | Very Low | 53 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-52 | B | Very Low | 54 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-53 | B | Very Low | 55 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-54 | B | Very Low | 56 | Weathervane | 4 | |
| Septic systems (serves one or more single-family homes) | R2 | R2-55 | B | Very Low | 57 | Weathervane | 4 | |
| Highways and roads, dirt/gravel | X24 | X24-1 | C | Very Low | 58 | Yarrow St. | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-2 | C | Very Low | 59 | Evergreen | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-3 | C | Very Low | 60 | Lupine | 3 | |

# Potential and Existing Sources of Contamination for National Outdoor Leadership School Volatile Organic Chemicals (VOCs)

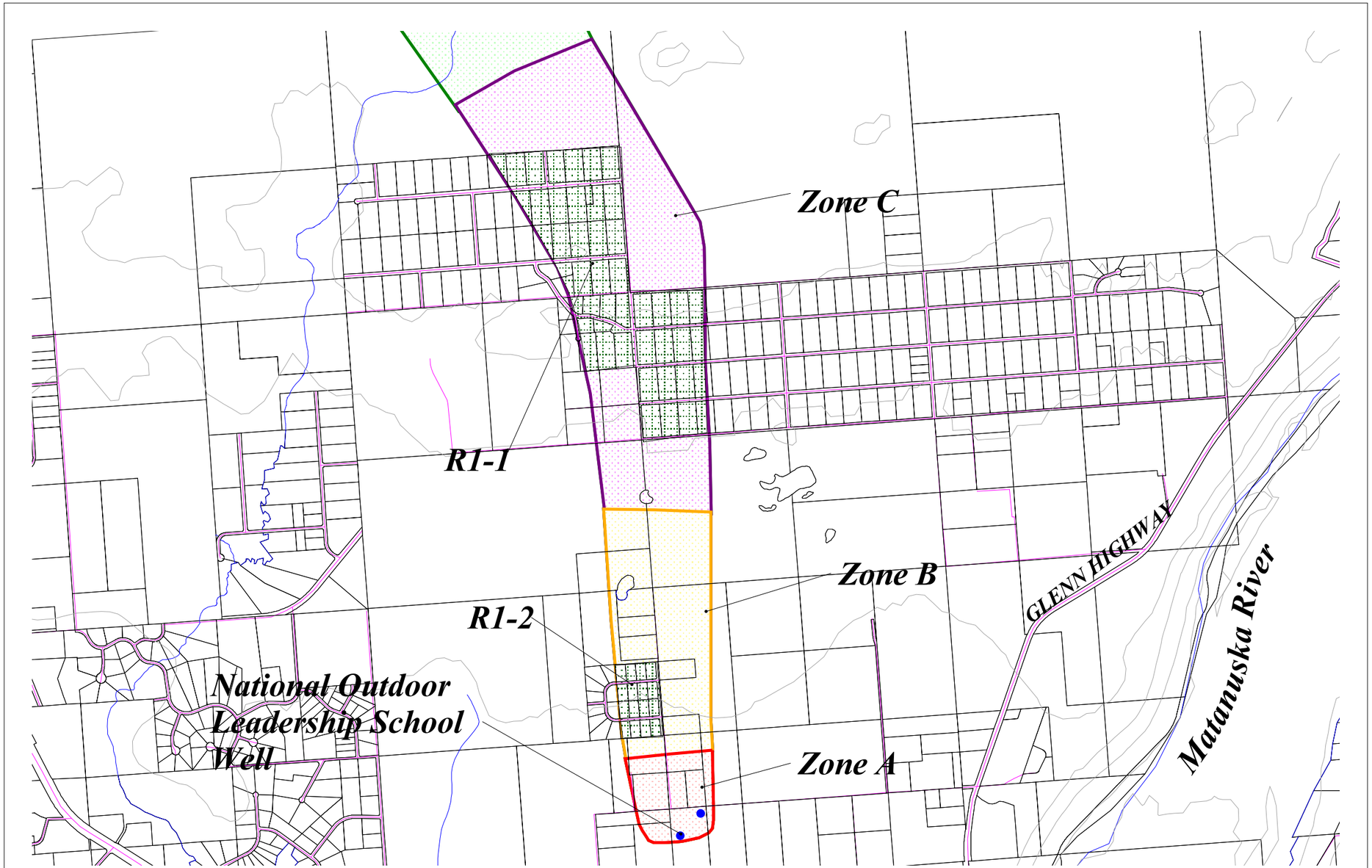


| Contaminant Source Category | Contaminant Source ID | CS ID Tag | Zone | Risk Ranking for Analysis | Overall Rank for Analysis | Location | Map | Comments |
|---|---|---|---|---|---|---|---|---|
| Highways and roads, dirt/gravel | X24 | X24-4 | C | Very Low | 61 | Hermann | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-5 | C | Very Low | 62 | Norman Dr | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-6 | C | Very Low | 63 | Norman St | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-7 | C | Very Low | 64 | Evergreen | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-8 | C | Very Low | 65 | Hermann | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-9 | C | Very Low | 66 | Norman Cr | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-10 | C | Very Low | 67 | Williams | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-11 | C | Very Low | 68 | Soapstone | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-12 | C | Very Low | 69 | Jensen | 3 | |
| Highways and roads, dirt/gravel | X24 | X24-13 | B | Very Low | 70 | Britchenstrap | 4 | |

# APPENDIX C

## National Outdoor Leadership School
## Drinking Water Protection Area
## and Potential & Existing Contaminant Sources

# Drinking Water Protection Areas Potential & Existing Sources of Contamination for National Outdoor Leadership School




N

- Public Water System Wells
- Zone A Protection Area Several Months to 2 Years Travel Time
- Zone B Protection Area Less Than 2 Years Travel Time
- Zone C Protection Area 2 to 5 Years Travel Time
- Roads
- Mat-Su Borough Parcel Boundaries
- Elevation Contours
- Lawn & Garden (R1)
- Lakes and Rivers

3000 0 3000 6000 Feet

*PWSID 227615.001*

## Map 2

Prepared by: B.E.S.T. Resource

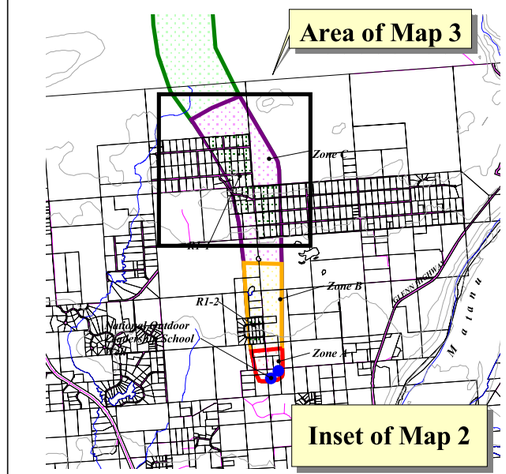
# Drinking Water Protection Area and Potential & Existing Sources of Contamination for National Outdoor Leadership School


2000 0 2000 4000 Feet

***PWSID 227615.001***

N

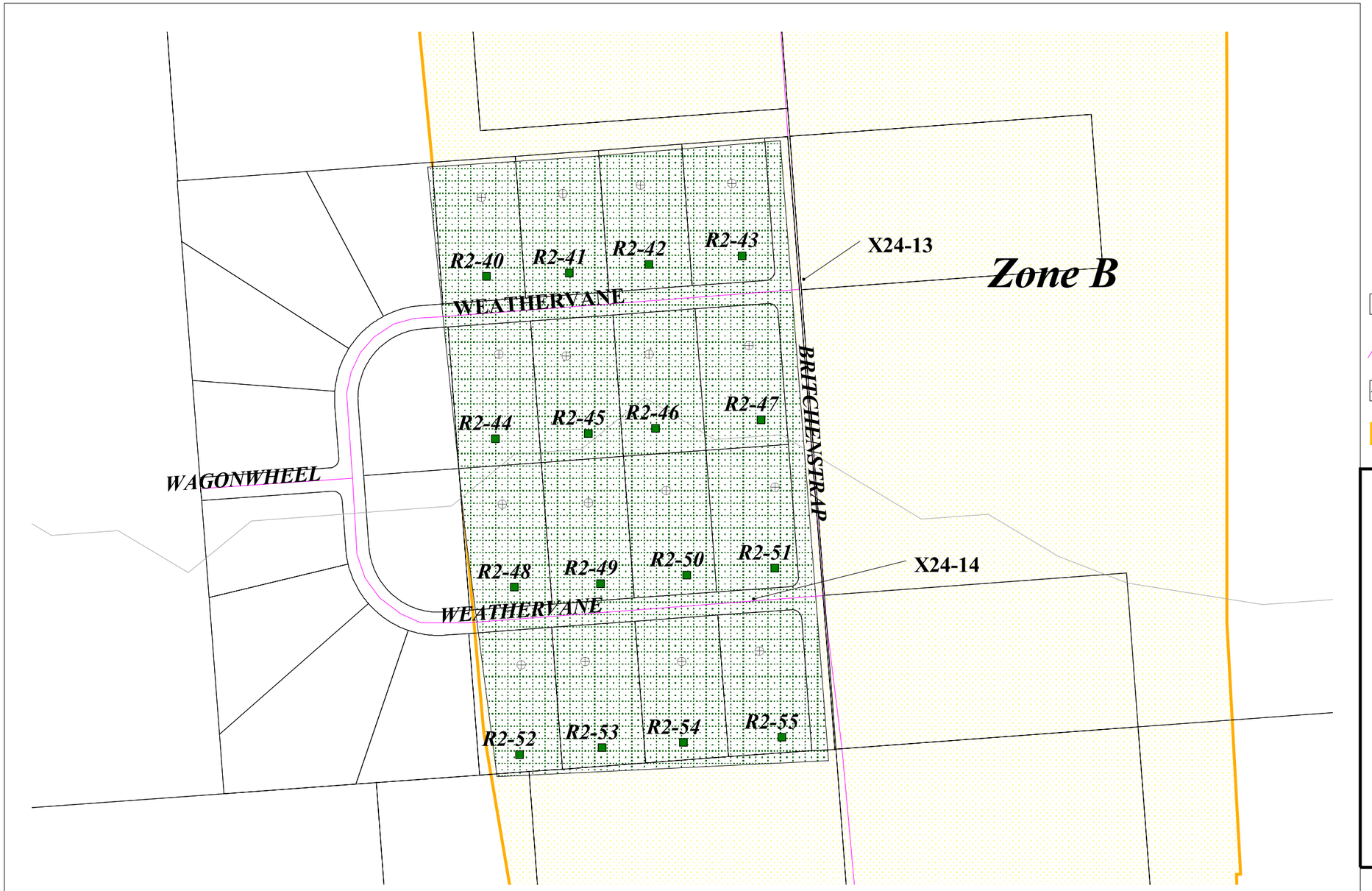
- Private & Public Drinking Water Wells
- Residential Septic Systems (R2)
- Elevation Contours
- Mat-Su Borough Parcels
- Roads (X24)
- Lawns & Gardens
- Zone C Protection Area




# Map 3

Prepared by: B.E.S.T. Resource

# Drinking Water Protection Area and Potential & Existing Sources of Contamination for National Outdoor Leadership School




400 0 400 800 Feet

*PWSID 227615.001*

N

Private & Public Drinking Water Wells

Residential Septic Systems (R2)

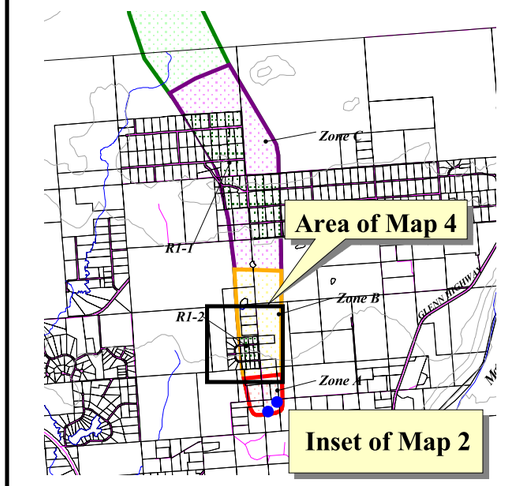
Elevation Contours

Mat-Su Borough Parcels

Roads (X24)

Lawns & Gardens

Zone B Protection Area



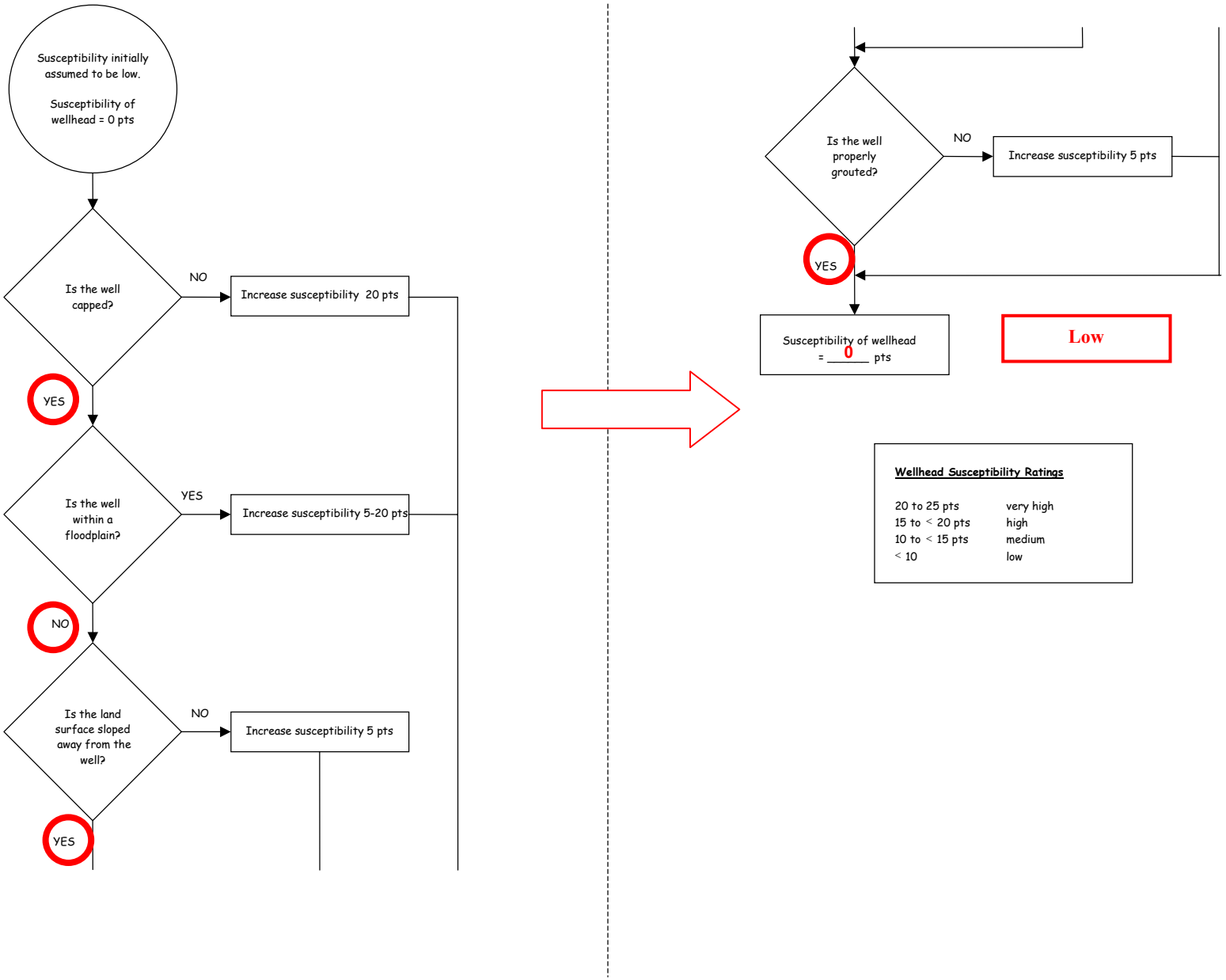

# Map 4

Prepared by: B.E.S.T. Resource

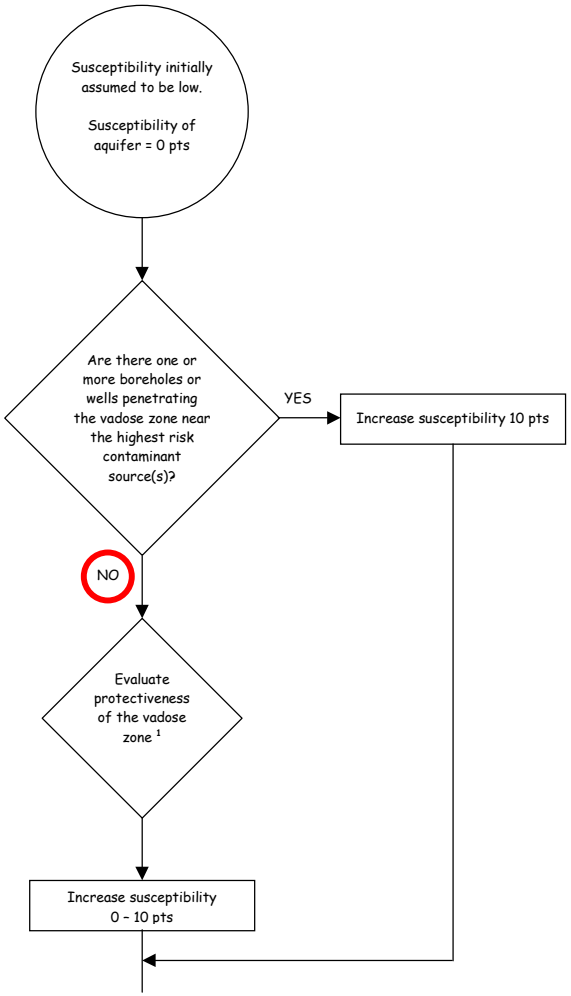
# APPENDIX D

## Vulnerability Analysis for National Outdoor Leadership School Public Drinking Water Source

***Chart 1. Susceptibility of the wellhead – National Outdoor Leadership School***



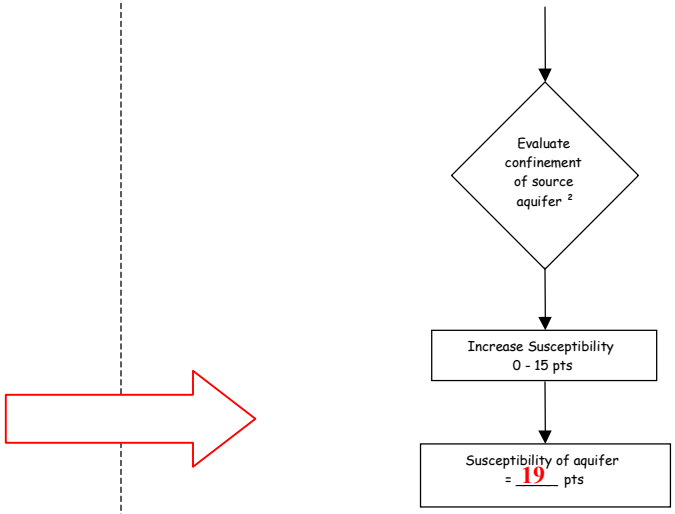
## *Chart 2. Susceptibility of the aquifer – National Outdoor Leadership School*




Recharge (16-20 inches per year, base of Talkeetna Mountains, gravelly sand, flat)
3/10 = 3 Points
Depth to bottom of confining unit (90 feet) 1/10 = 1 Point

Protectiveness of the Vadose Zone Total = **4/10 Points**

**4 Points**




Confinement (unconfined with 90' of gravely sand) 15/15 = 10 Points
Density of boreholes/wells (2 holes in Zone A) 15/15 = 5 Point

Degree of Confinement Total = **15/15 Points**

**15 Points**

**High**

**Aquifer Susceptibility Ratings**

| | |
|---|---|
| 20 to 25 pts | very high |
| 15 to < 20 pts | high |
| 10 to < 15 pts | medium |
| < 10 | low |

1. **Protectiveness of the Vadose Zone**
   - net recharge (function of precipitation, slope of land surface, & permeability of soils) [0-10 pts: 50%]
   - depth to water table (unconfined aquifer) or top of confining layer (confined aquifer) [interpolate linearly: 100'- 20', 0-5 pts; 20' - 0', 5-10 pts; 50% weight]

2. **Degree of Confinement**
   - confined verses unconfined aquifer [confined: K $\leq 10^{-6}$ cm/s, minimum thickness of at least one layer = 20 ft, interpolate linearly 100' - 20', 0 - 10 pts; unconfined = 15 pts; 65%]
   - density of boreholes and wells penetrating the confining layer (confined aquifer) or the water table (unconfined aquifer) [confined: 0 - 15 pts; unconfined = 15 pts; 35% weight]

***Chart 3. Contaminant risks for National Outdoor Leadership School – Bacteria & Viruses***

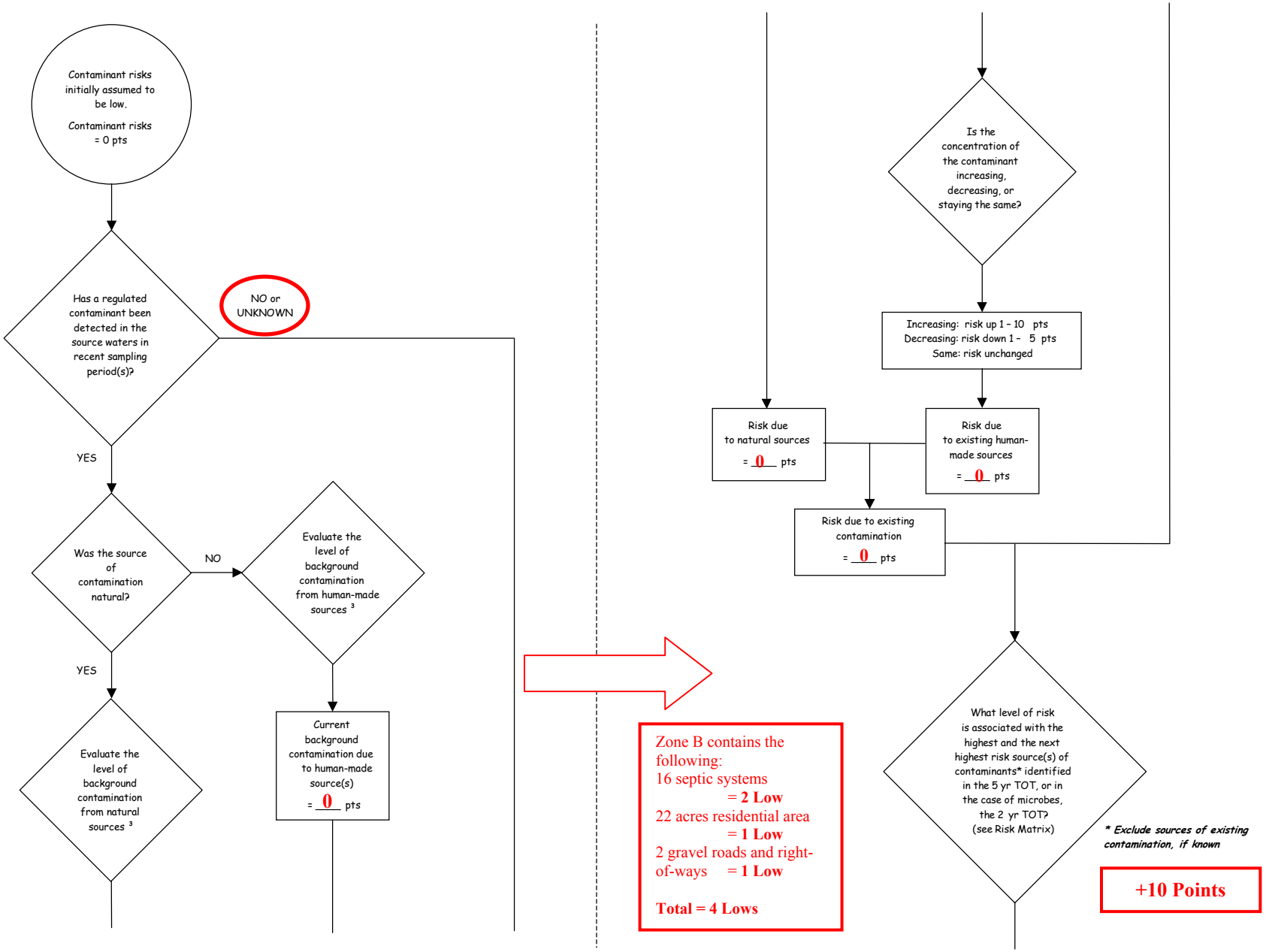


*Chart 3. Contaminant risks for National Outdoor Leadership School – Bacteria & Viruses (Continued)*

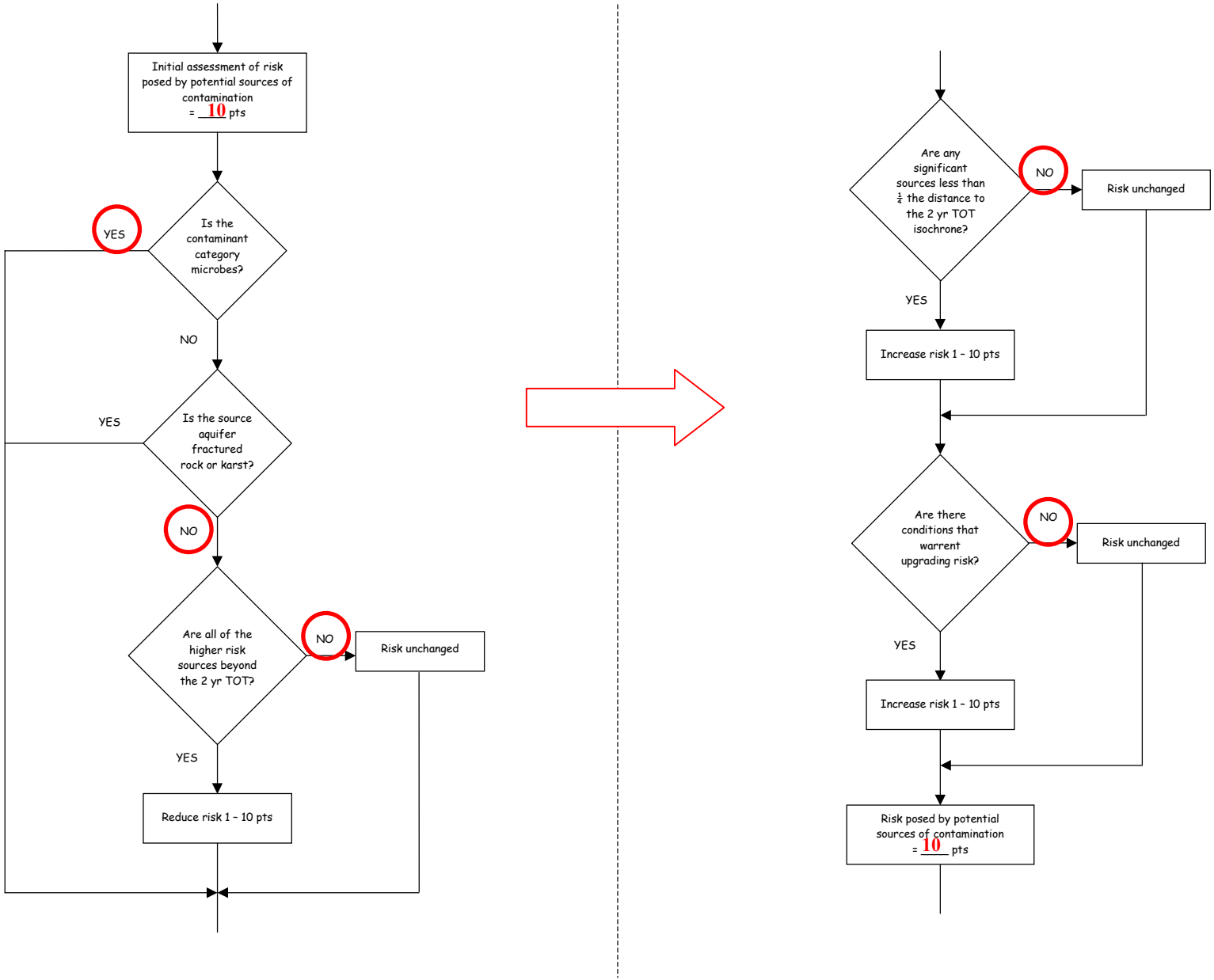
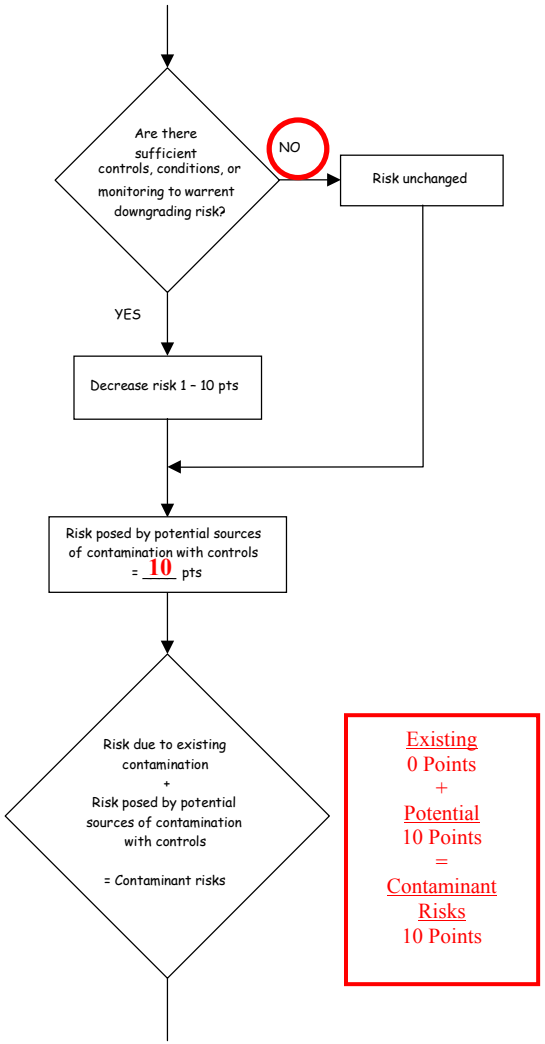
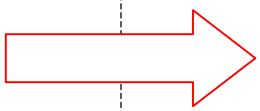
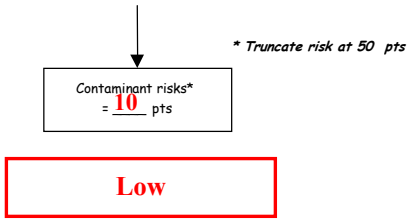


*Chart 3. Contaminant risks for National Outdoor Leadership School – Bacteria & Viruses (Continued)*




Existing
0 Points
+
Potential
10 Points
=
Contaminant Risks
10 Points






**3. Level of Background Contamination**

| | |
|---|---|
| > MCL | 21 - 50 pts |
| 0.5 MCL to < MCL | 11 - 20 pts |
| 0.2 MCL to < 0.5 MCL | 6 - 10 pts |
| 'detect' to < 0.2 MCL | 0 - 5 pts |

**Contaminant Risk Ratings**

| | |
|---|---|
| 40 to 50 pts | very high |
| 30 to < 40 pts | high |
| 20 to < 30 pts | medium |
| < 20 | low |

**Table 1. Risk Matrix for Contaminant Sources for National Outdoor Leadership School – Bacteria & Viruses**

**Level of Risk Associated with the Highest Risk Sources**

| **Next Highest Risk Sources(s)** | 16 residential septic systems, 2 roads, and 22 acres of residential area | **LOW 10 pts** | **MEDIUM 20 pts** | **HIGH 30 pts** | **VERY HIGH 40 pts** |
|---|---|---|---|---|---|
| **Low** | | ≥ 10 sources + 10 pts | ≥ 10 sources + 5 pts | ≥ 20 sources + 5 pts | — |
| **Medium** | | — | ≥ 2 sources + 5 pts | ≥ 5 sources + 5 pts | ≥ 10 sources + 5 pts |
| **High** | | — | — | 1 source + 10 pts | ≥ 2 sources + 10 pts |
| **Very High** | | — | — | — | 1 source + 10 pts |

*Chart 4. Vulnerability analysis for National Outdoor Leadership School – Bacteria & Viruses*

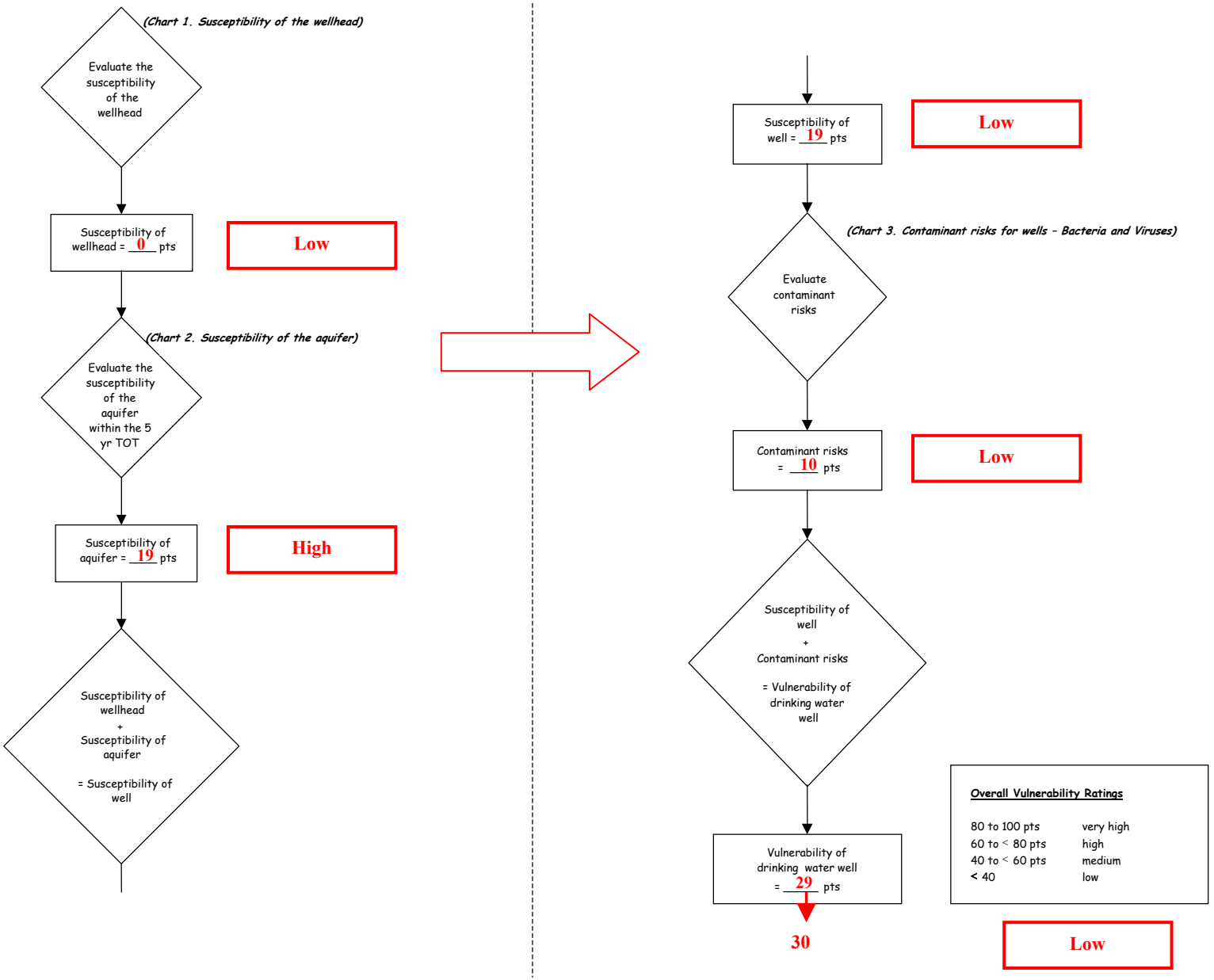


***Chart 5. Contaminant risks for National Outdoor Leadership School – Nitrates and Nitrites***

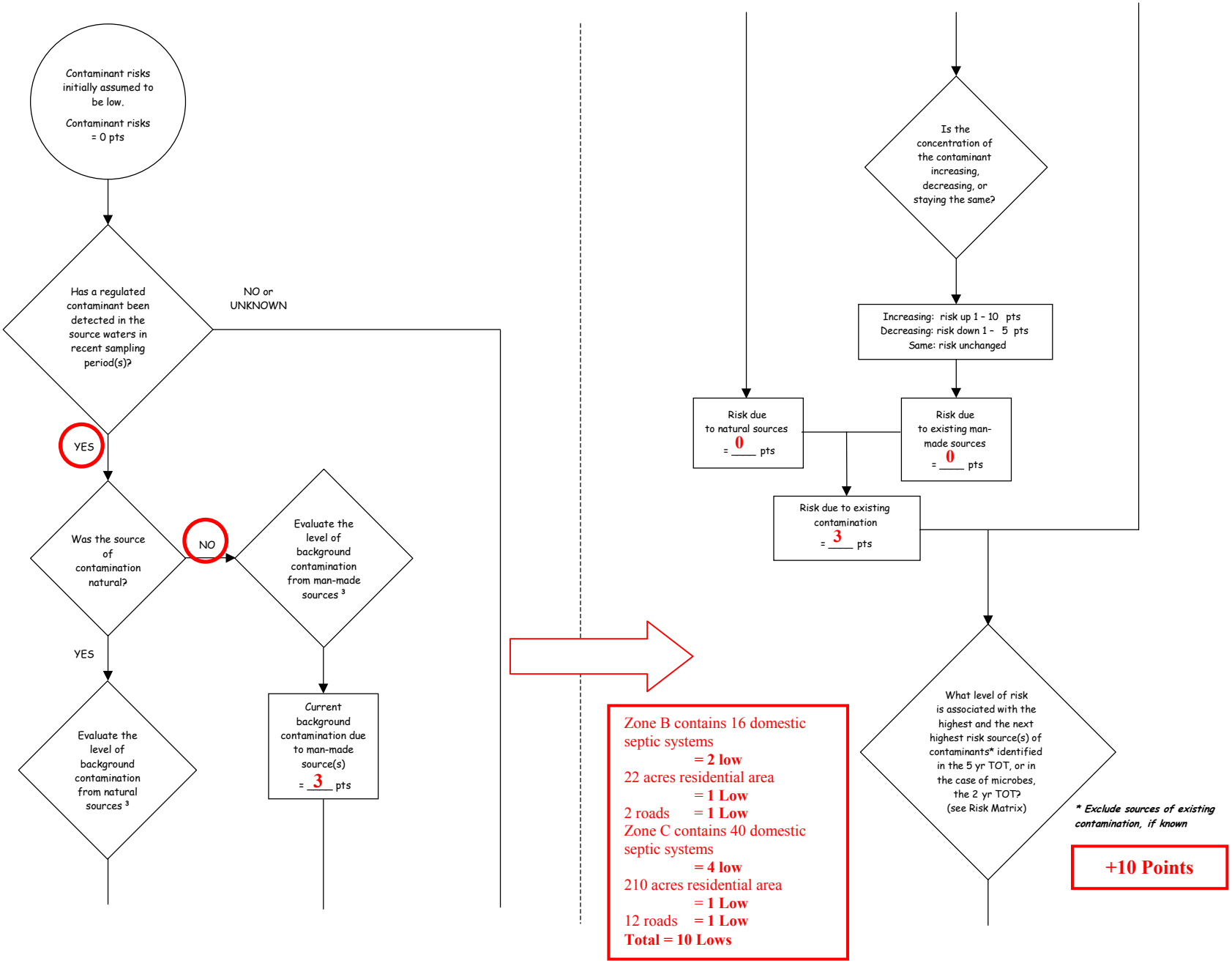


*Chart 5. Contaminant risks for National Outdoor Leadership School – Nitrates and Nitrites (Continued)*

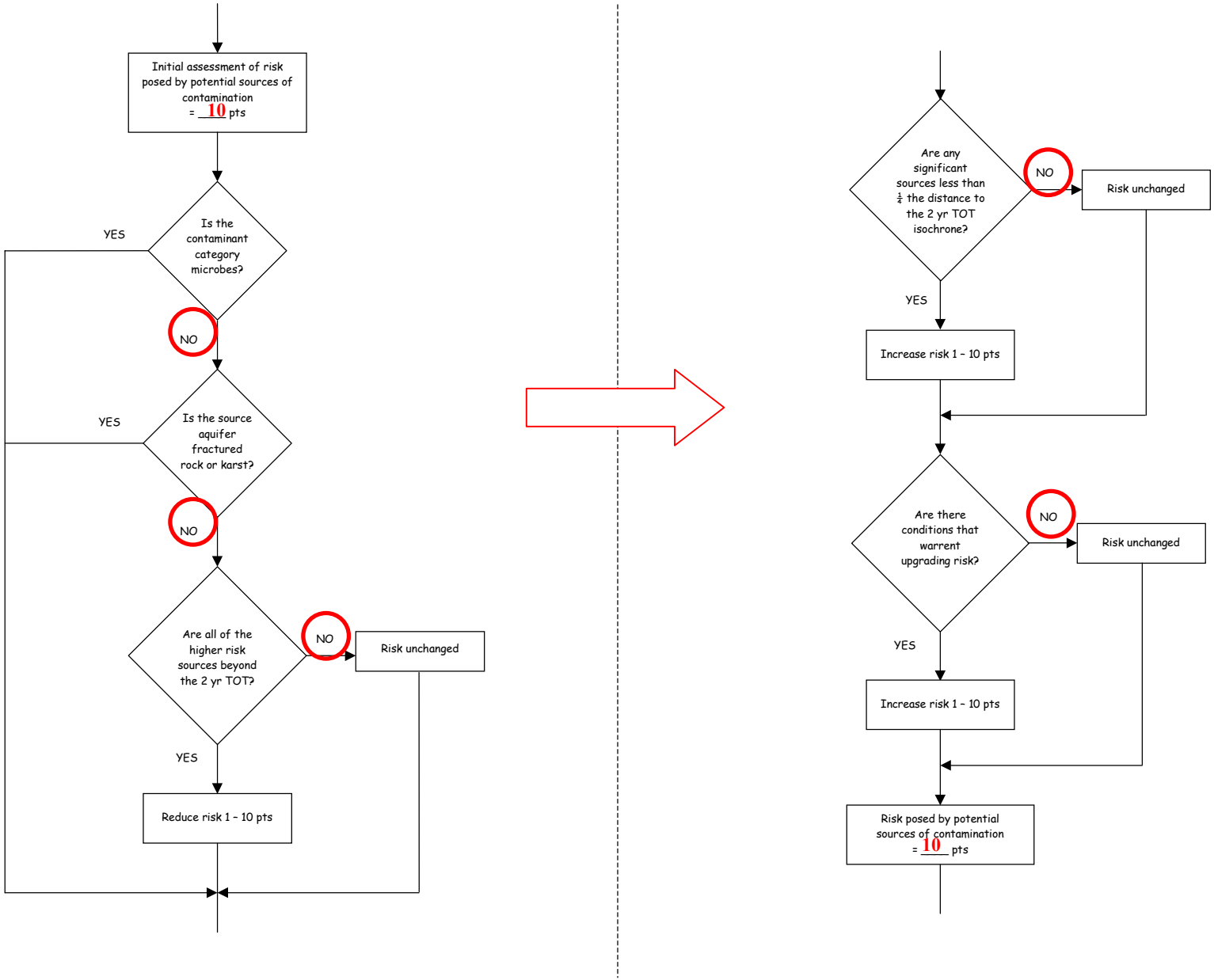
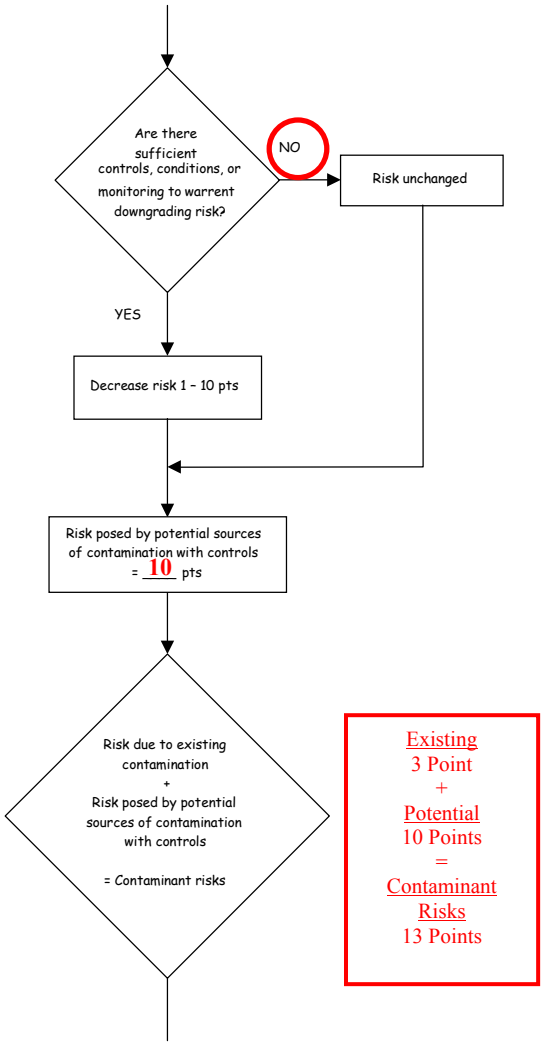
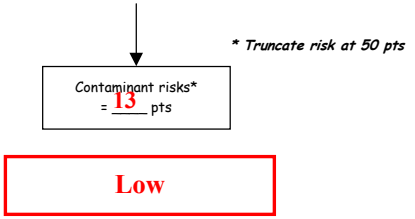


*Chart 5. Contaminant risks for National Outdoor Leadership School – Nitrates and Nitrites (Continued)*




Existing
3 Point
+
Potential
10 Points
=
Contaminant
Risks
13 Points




**3. Level of Background Contamination**

| | |
|---|---|
| > MCL | 50 pts |
| 0.5 MCL to < MCL | 20 pts |
| 0.2 MCL to < 0.5 MCL | 10 pts |
| 'detect' to < 0.2 MCL | 5 pts |

**Contaminant Risk Ratings**

| | |
|---|---|
| 40 to 50 pts | very high |
| 30 to < 40 pts | high |
| 20 to < 30 pts | medium |
| < 20 | low |

**Nitrate**
0.35 mg/L on 9/25/00
0.37 mg/L on 9/25/00
0.392 mg/L on 3/16/00
0.52 mg/L on 9/28/99
0.38 mg/L 6/10/96
0.23 on 9/7/95

Maximum Contaminant Level (MCL)
= 10mg/L
0.035/10
= 0.35 or 0.3% of MCL

**+3 Point**

**Table 2. Risk Matrix for Contaminant Sources for National Outdoor Leadership School – Nitrates and Nitrites**

**Level of Risk Associated with the Highest Risk Sources**

| 56 septic systems, 14 roads, and 232 acres of residential area | **LOW 10 pts** | **MEDIUM 20 pts** | **HIGH 30 pts** | **VERY HIGH 40 pts** |
|---|---|---|---|---|
| **Low** | > 10 sources + 10 pts | > 10 sources + 5 pts | > 20 sources + 5 pts | --- |
| **Medium** | --- | > 2 sources + 5 pts | > 5 sources + 5 pts | > 10 sources + 5 pts |
| **High** | --- | --- | 1 source + 10 pts | > 2 sources + 10 pts |
| **Very High** | --- | --- | --- | 1 source + 10 pts |

*Chart 6. Vulnerability analysis for National Outdoor Leadership School – Nitrates and Nitrites*

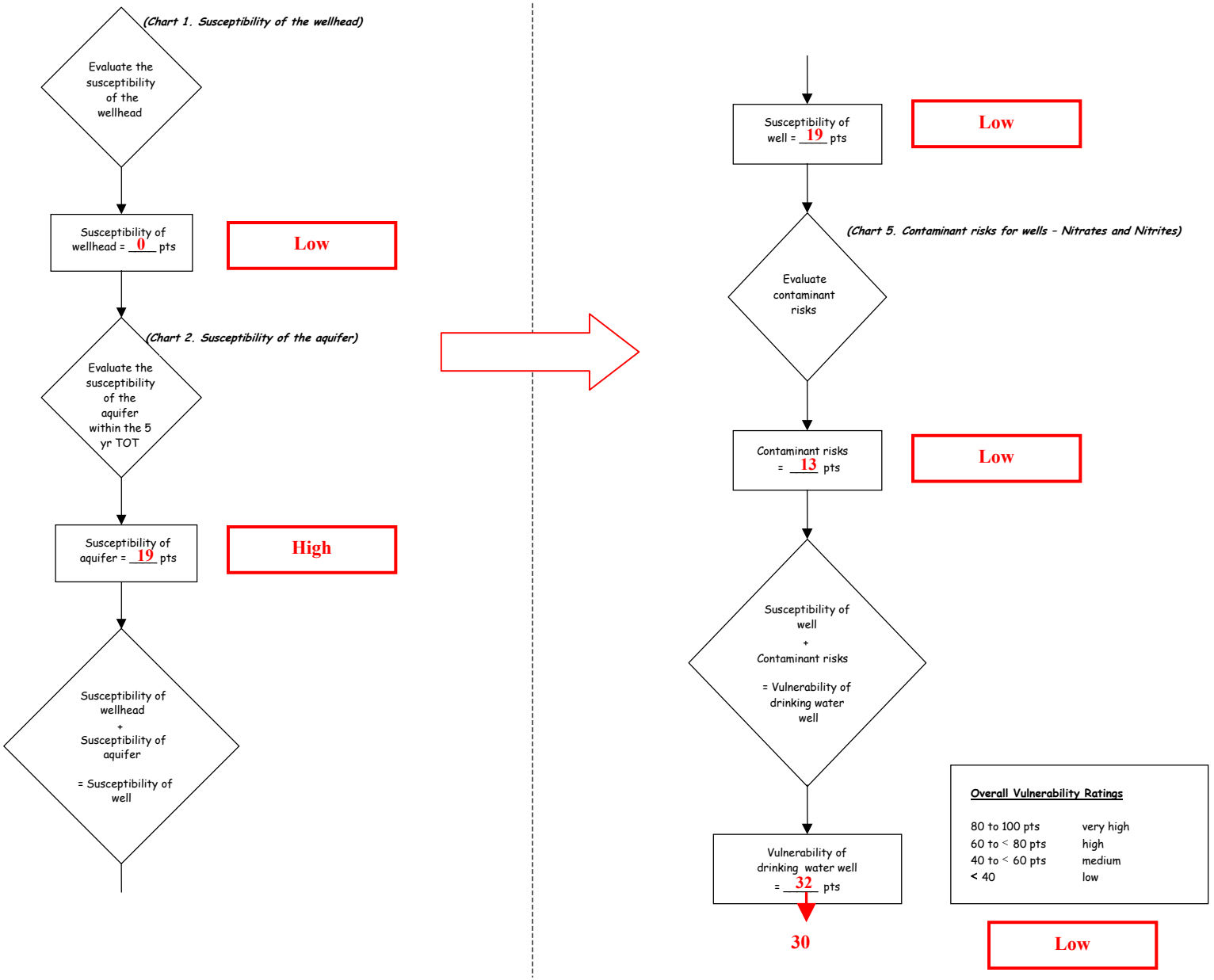


***Chart 7. Contaminant risks for National Outdoor Leadership School – Volatile Organic Chemicals***

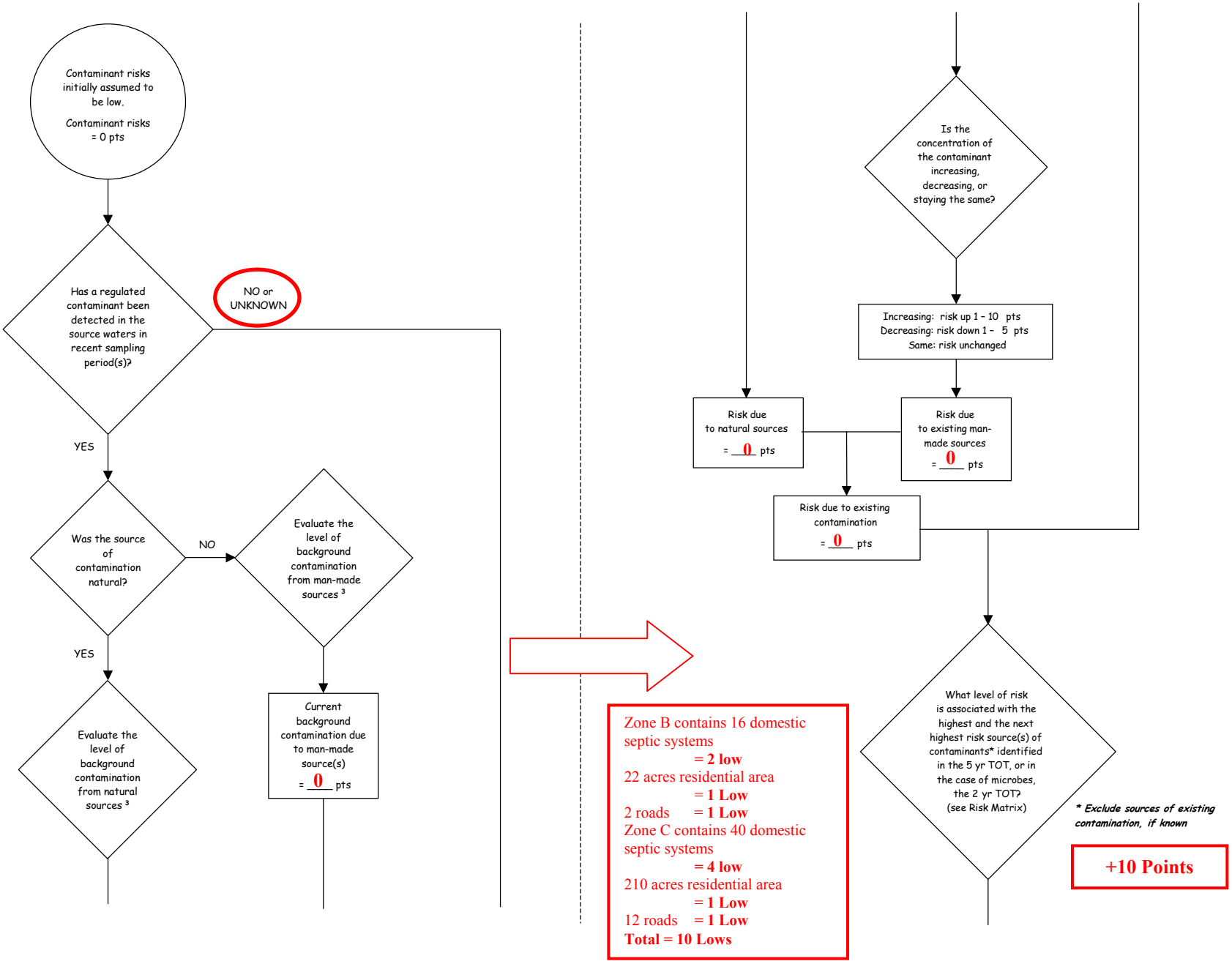


***Chart 7. Contaminant risks for National Outdoor Leadership School – Volatile Organic Chemicals (Continued)***

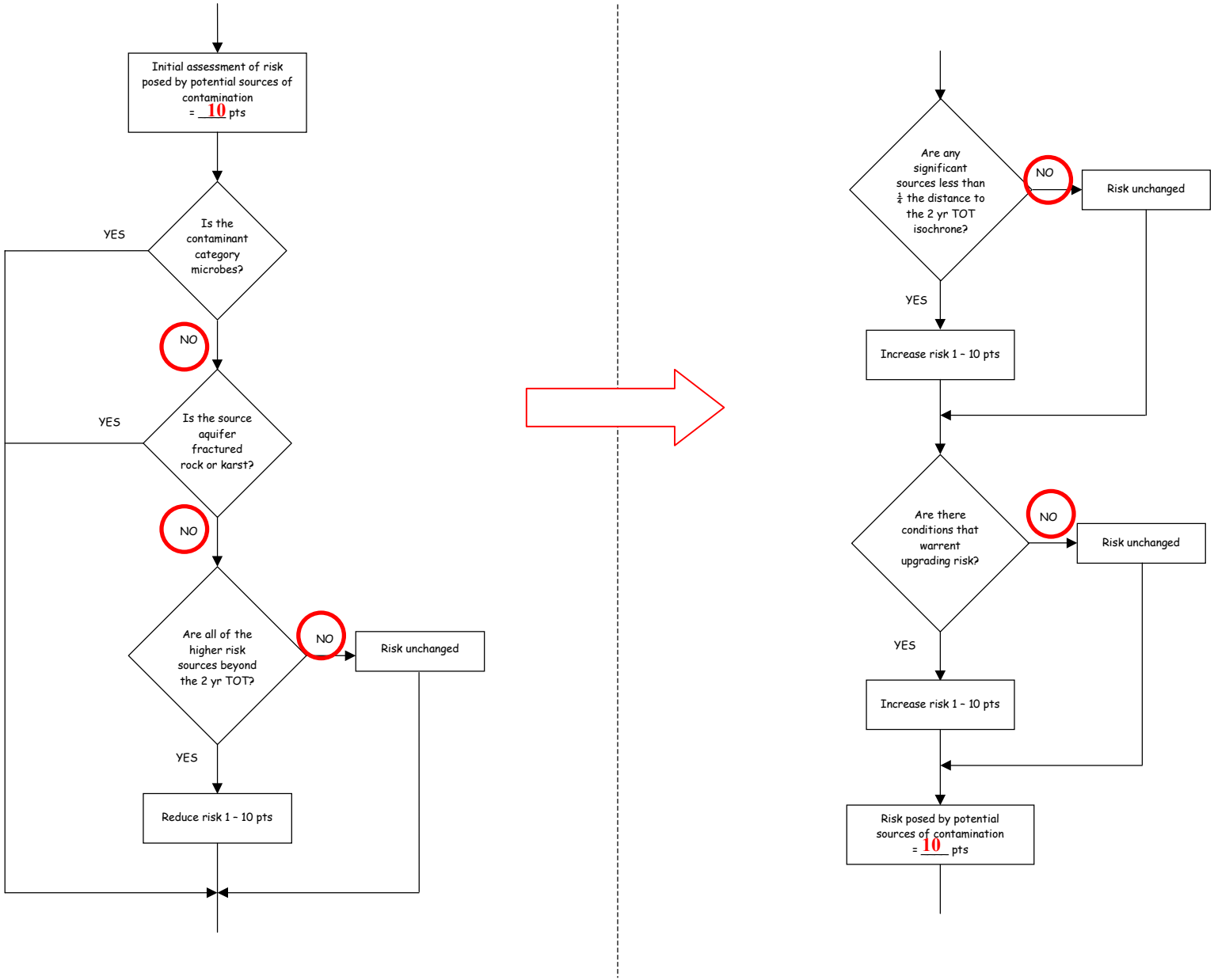
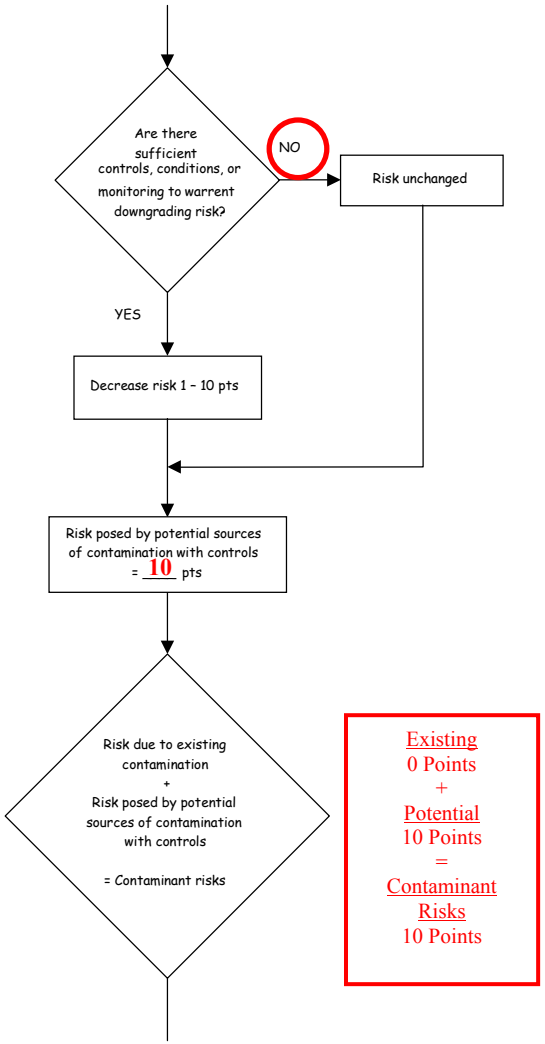
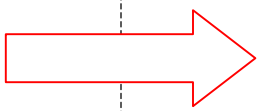
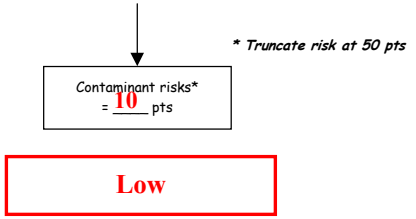


***Chart 7. Contaminant risks for National Outdoor Leadership School – Volatile Organic Chemicals (Continued)***




Existing
0 Points
+
Potential
10 Points
=
Contaminant Risks
10 Points






**3. Level of Background Contamination**

| | |
|---|---|
| > MCL | 50 pts |
| 0.5 MCL to < MCL | 20 pts |
| 0.2 MCL to < 0.5 MCL | 10 pts |
| 'detect' to < 0.2 MCL | 5 pts |

**Contaminant Risk Ratings**

| | |
|---|---|
| 40 to 50 pts | very high |
| 30 to < 40 pts | high |
| 20 to < 30 pts | medium |
| < 20 | low |

**Table 3. Risk Matrix for Contaminant Sources for National Outdoor Leadership School – Volatile Organic Chemicals**

**Level of Risk Associated with the Highest Risk Sources**

**Next Highest Risk Sources(s)**

| 56 residential sewer systems, 14 roads, 232 residential acres | **LOW 10 pts** | **MEDIUM 20 pts** | **HIGH 30 pts** | **VERY HIGH 40 pts** |
|---|---|---|---|---|
| **Low** | > 10 sources + 10 pts | > 10 sources + 5 pts | > 20 sources + 5 pts | --- |
| **Medium** | --- | > 2 sources + 5 pts | > 5 sources + 5 pts | > 10 sources + 5 pts |
| **High** | --- | --- | 1 source + 10 pts | > 2 sources + 10 pts |
| **Very High** | --- | --- | --- | 1 source + 10 pts |

*Chart 8. Vulnerability analysis for National Outdoor Leadership School – Volatile Organic Chemicals*